



As an alternative to manual retraction, the depositor of this invention has filed an Italian patent application having protocol number V198U000098 which describes a heavy vehicle for breaking up ground in which the changeover of one or both rear wheels or tracks from extracted to retracted into the frame and vice versa, as well as locking them in their final position, is achieved automatically by controls inside the driver's cab.

One limitation shown by the machine described in the aforementioned patent is that when the rear wheels or tracks are set in their retracted position inside the frame, when turning they scrape the ground with considerable resistance. This problem is particularly accentuated when the machine is fitted with tracks rather than wheels, because in this case the resistance while turning is even higher because of the greater surface area in contact with the ground.

### SUMMARY OF THE INVENTION

This invention sets the scope of eliminating this inconvenience by producing a machine for breaking up ground provided with at least one rear steering wheel or track. An additional scope is that these steering wheels or tracks can also retract into the side of the machine.

Said scopes are achieved by producing a machine for breaking up ground that in accordance with the main claim comprising:

a frame supported by at least one pair of front wheels or tracks and by at least one pair of rear wheels or tracks;

at least one driver's cab being part of said frame;

means of breaking up the ground connected to said frame;

traction systems supported by said frame to rotate one or more of said wheels or said tracks;

wherein at least one of said rear wheels or said rear tracks has its horizontal axis belonging to a chassis being an integral part of said frame and having at least one first actuator that works with maneuvering systems accessible from said driver's cab to rotate said rear wheel or track around a vertical axis while turning the machine's front wheels.

According to a preferred form of execution the machine is a scarifier mounted on tracks where the two front tracks are both steering and two rear ones, one being fixed and one retractable and steering.

The means of turning the machine include first actuators that work with the rear wheel or track and second actuators that work with both front wheels or tracks, which consist of hydraulic cylinders supplied by slide valves. In particular the slide valve that operates the steering hydraulic cylinder of the rear track is controlled by solenoid valves, while the slide valve that supplies the hydraulic cylinder for steering the front tracks is controlled directly by the power steering connected to the steering column in the driver's cab. The operation of both hydraulic cylinders is interlinked by means of controls to co-ordinate turning, which include potentiometric position detectors or similar, cooperating mechanically with each hydraulic cylinder and electrically wired to an electronic control unit. This is also electrically wired to the solenoid valves that pilot the slide valves supplying the hydraulic cylinder steering the rear track and a position signal for the rear wheel or track when it is set in its retracted position inside the frame.

An advantage of the scarifier invention is that it is easier to drive above all during turning operations.

Another advantage is that the wear on the tracks is also reduced.

### BRIEF DESCRIPTION OF THE DRAWINGS

The aforesaid scopes and advantages will be better illustrated during the description of a preferred form of execution of the invention that is given as a guideline but not a limitation and refers to the attached diagrams where:

- Fig. 1 illustrates a line drawing of the side view of the machine invention;  
Fig. 2 illustrates in an isometric drawing of a detail of the machine in Fig. 1;  
Fig. 3 illustrates an aerial view of the detail in Fig. 2;  
Figures 4 to 6 illustrate line drawings of aerial views of the set-up of the tracks on the machine in Fig. 1 in three different working positions;  
Fig. 7 shows the hydraulic control diagram of the tracks of the machine in Fig. 1 and electrical wiring of the control unit.

### DESCRIPTION OF THE INVENTION

As seen in Fig. 1 the machine invention, generally indicated by 1, is a scarifier suited for breaking up the bituminous surface that covers road courses. The concepts

that will be described below can nevertheless be applied to a machine for breaking up other kinds of terrain.

The scarifier includes a frame 2, supported by a pair of front tracks 3, 3' and by a pair of rear tracks 4, 4', which is shaped to provide a driver's cab generally indicated by 5.

To the rear of the machine and between the rear tracks 4, 4' there is a ripper drum 6 that is rotated around its horizontal axis 6' by traction systems inside the frame 2 and not illustrated here, which by means of gears and mechanisms, again not illustrated here, also rotate one or more of said tracks. It is clear that in different executions the machine invention may be fitted with wheels instead of tracks.

According to the invention at least one of said rear wheels or tracks 4 has its horizontal axis 7 belonging to a chassis 8 being a integral part of said frame 2 and having at least one first actuator 9 that works with maneuvering systems 10 accessible from said driver's cab 5 to rotate said rear wheel or track 4 around a vertical axis 13 while turning the front wheels or tracks 3, 3' of the machine.

In particular the maneuvering systems consist of the machine's steering column 10.

As seen in Fig. 2 and also in Fig. 3 the chassis generally indicated by 8 that support the rear track 4, includes a yoke 12 connected to the track 4, having a vertical pivot journal 13 that is coupled to revolve on a support plate 14 fixed to a second actuator 15 being a integral part of the frame 2.

In detail, as seen in Fig. 4, the second actuator 15 is a second hydraulic jack that has the end of its rod 16 fixed to the plate 14 and the cylinder end 17 where the rod 16 slides, being integral with the frame 2 of the machine.

~~In particular the cylinder 17, as seen in Fig. 4, is connected to the frame 2 by means of a first articulation generally indicated by 18 and of the type described in the aforementioned Italian patent V198U000098. The first actuation group comprises a four- bar linkage wherein the bars 18a and 18b are moved by hydraulic actuators. This allows the whole chassis 8 to move with the track 4 connected to it, in any one of the directions of the arrow 19 with reference to a fixed point 20 on the frame, to retract the track 4 into frame of the machine as seen in Fig. 1.~~

With regards to the first actuator generally indicated by 9 and belonging to the chassis 8, it can be seen that it consists of a first hydraulic jack that, as seen in fig.'s 2 and 3, has the rod end 21 hinged to the yoke 12 while the cylinder end 22, where the rod 21 slides, is hinged to the plate 14.

With regards to the front tracks 3, 3' it can be seen in fig. 4 that each of them is supported by a chassis 23, 23' that couples it to revolve on a pivot journal 24, 24' connected vertically to the frame 2.

The front tracks 3, 3' are moreover interlinked by means of a second articulation generally indicated by 25 that is made up of a central rod 26 hinged to a pair of side rods 26', 26'', each of them in turn being hinged to their relative chassis 23, 23' respectively of the front tracks 3, 3'.

It can also be seen that the front track 3 works with a third actuator generally indicated by 27 that consists of a third hydraulic jack having the rod end 28 hinged to the chassis 23 and the cylinder end 29, where the rod 28 slides, hinged to the frame 2 of the machine.

When the rod 28 thrusts in or out of its relative cylinder 29, it forces the chassis 23 to rotate around the vertical axis or pivot journal 24 and by means of the second articulation 25 also transmits this rotation to the front track 3' next to it, making the machine turn.

It can be seen in Fig. 7 that the first and third hydraulic jacks or first actuator 9 and third actuator 27, respectively, are supplied by the pressurized oil distribution circuit generally indicated by 30. This includes a first slide valve 31 piloted by solenoid valves 31' and 31'' that supply the first hydraulic jack 9 and by a third slide valve 32 that is controlled by the steering column or maneuvering system 10 of the machine, which supplies the third hydraulic jack or third actuator 27.

The distribution circuit also includes a first position detector 33 of the first hydraulic jack 9 and a third position detector 34 of the third hydraulic jack 27 that consist of potentiometric position detectors or similar, connected to an electronic control unit 35 for the coordinated control of the turning angles of the front tracks 3, 3' and the rear track 4.

It can be seen that there is also a position signal 36 preferably consisting of a travel switch that detects the retracted position of the rear track 4.

The travel switch 36 together with the potentiometric detectors 33, 34' and the solenoid valves 31', 31'', are electrically wired to the electronic control unit 35 that coordinates their operation, controlling the turn.

A pump 37 completes the circuit.

It works so that when the machine's traction systems are operating, adjusting the steering column or maneuvering system 10 by turning it in any of the directions indicated by the arrow 40, pressure is applied to the third actuator or hydraulic jack 27

that turns the front tracks 3, 3', for instance making them turn counterclockwise 38 as illustrated in Fig. 6 around a pivot center 39.

The third position detector 34 transmits the signal to the electronic control unit 35, which operates the solenoid valve 31' or 31" of the first actuator or hydraulic jack 9, causing a rotation also for the track 4 according to a calculated geometry in the same counterclockwise direction 38 around the same pivot center 39.

The third position detector 34 keeps control of how the turn is progressing by sending signals to the electronic control unit 35.

The position signal 36 detects when the rear track 4 is in its retracted position inside the frame that can be seen in Fig. 6.

It is nevertheless clear that the rear track 4 can also be turned when it is in its extracted position.

The track 4 is set in its retracted position inside the frame and then is reset in the extracted position that can be seen in Fig. 4 by acting from inside the driver's cab by means of control systems of the first articulation 18, that has not been illustrated, that is thereby made to turn in any of the directions of the arrow 19 and whose operation is illustrated in the aforementioned Italian patent V198U000098.

The above description amply shows that the machine invention achieves all the set scopes.

In a different form of execution, the machine invention may have both rear tracks steering.

In the execution phase, the machine invention may undergo changes or variations in construction all falling under the protection of the main claim that shall therefore all be considered protected by this patent.